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None

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INT CL[4] G01N 21/00 21/17 21/47 21/49 21/53 21/59
Databases searched: WPI

(54) **Water monitor**

(57) An instrument is provided for monitoring a stream of water in a glass tube (12) for the presence of both ferric floc and an organic liquid immiscible with water. Infra-red light from a source (14) is passed into the water, and the scattered light is monitored with a detector (22). Green light from a source (16) is passed through the water and a detector (26) monitors the transmitted intensity. From these two measurements the concentrations of the ferric floc and of the organic liquid can be calculated. To obtain reliable measurements, means (20; 15, 25, 28) are provided to enable any changes in the emitted light intensities or detector efficiencies to be taken into account or eliminated. The organic liquid may be kerosene.

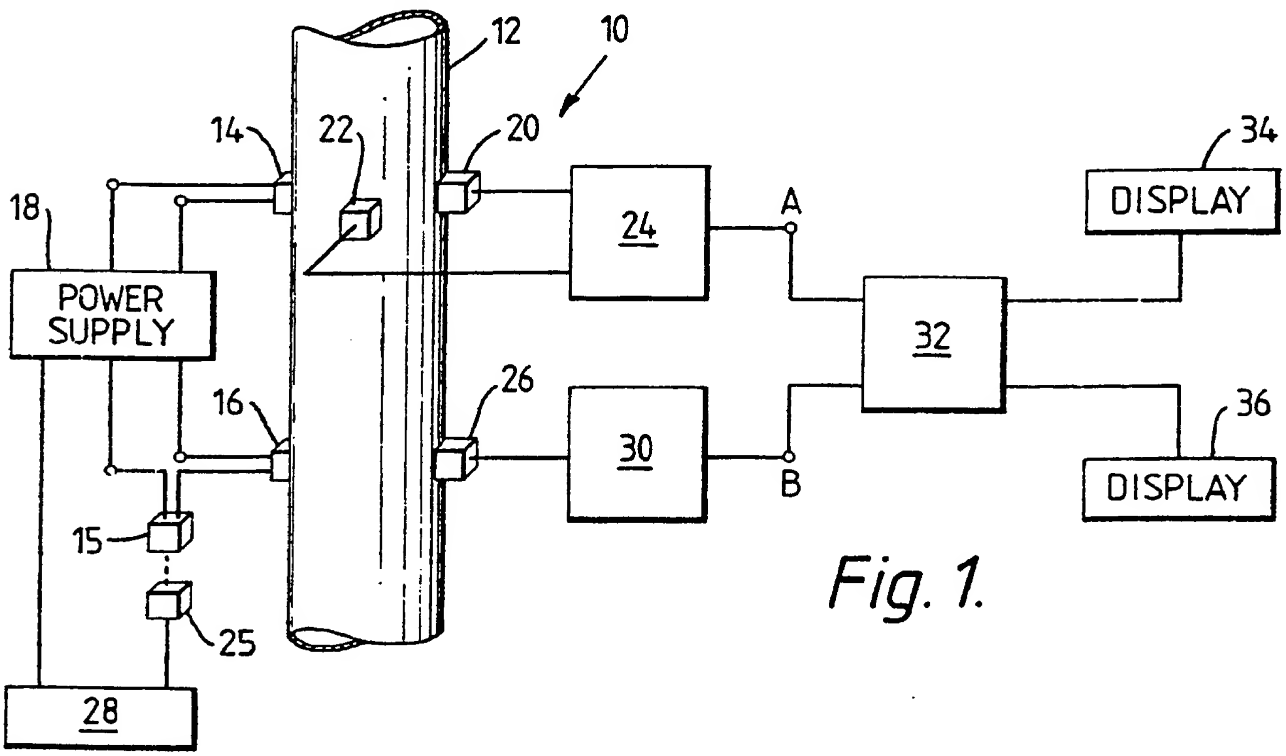

Fig. 1.

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.
The print reflects an assignment of the application under the provisions of Section 30 of the Patents Act 1977.

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Fig. 1.

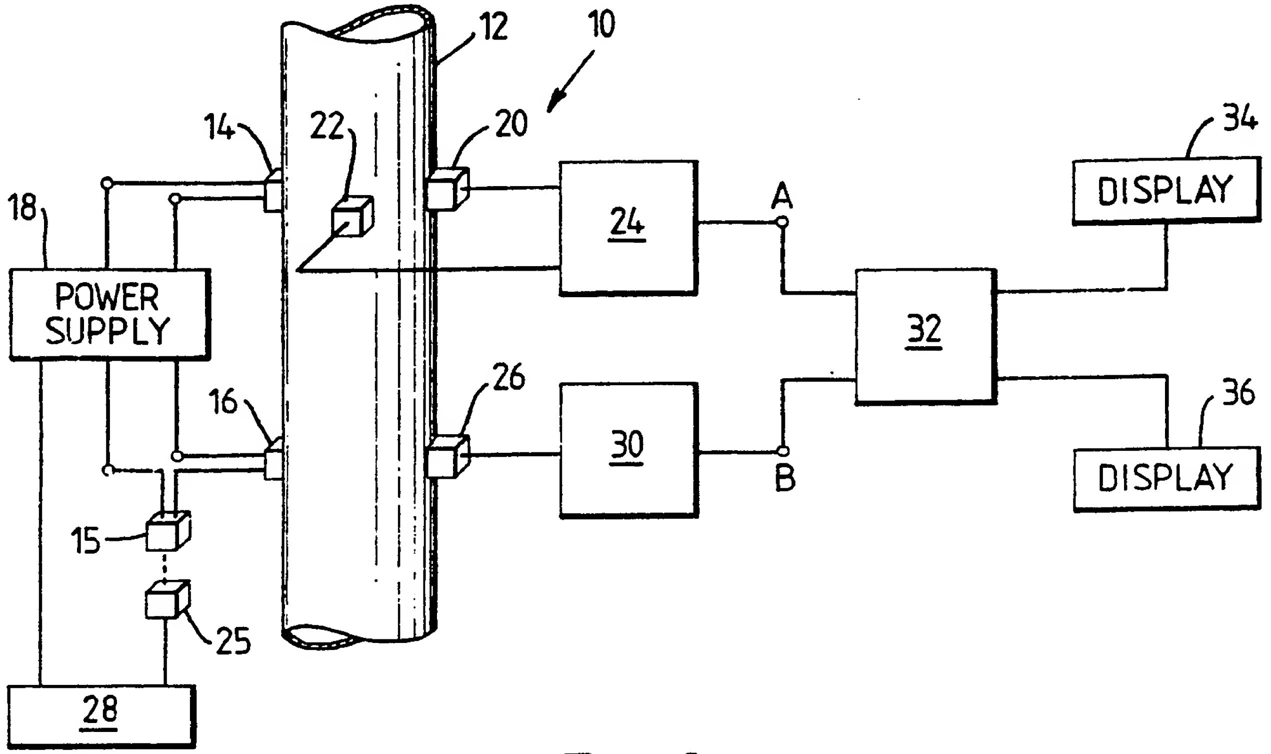
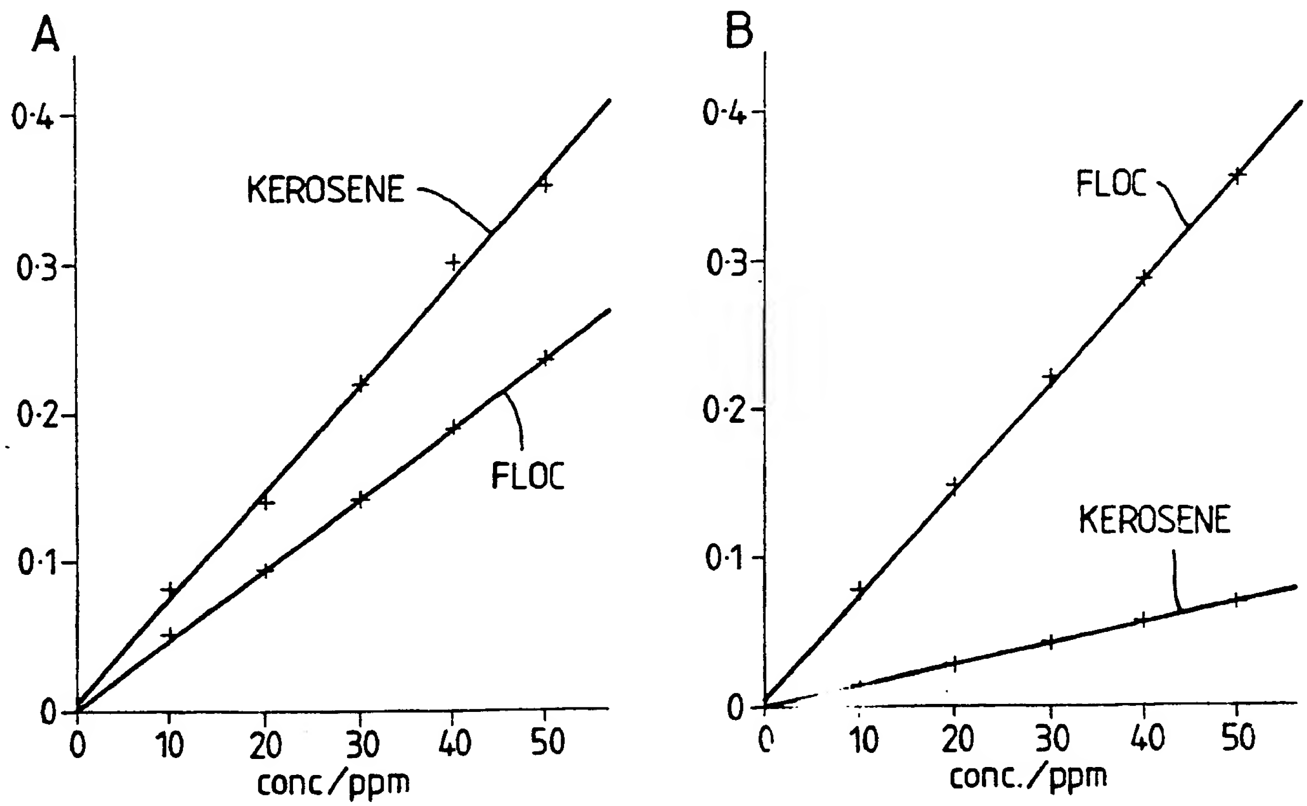

12
10
14
22
20
34
DISPLAY
18
24
A
POWER SUPPLY
32
16
26
36
30
B
DISPLAY
15
25
28

Fig. 2.


A
0·4
0·3
0·2
0·1
0
KEROSENE
FLOC
0
10
20
30
40
50
conc/ppm
B
0·4
0·3
0·2
0·1
0
FLOC
KEROSENE
0
10
20
30
40
50
conc./ppm

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Water Monitor

The invention relates to a method and an instrument for monitoring water to detect small quantities of organic liquid.

A bilge-water monitor is commercially available (from Babcock-Bristol Ltd., of Purley Way, Croydon, England) which monitors for small quantities of oil in water (for example about 10 parts per million (ppm)) by measuring the extent to which infra-red light is scattered when passed through a sample of bilge-water.

According to the present invention there is provided an instrument for monitoring for the presence in water of both ferric floc and an organic liquid immiscible with water, the instrument comprising means for passing infra-red light through the water, and first sensor means for sensing the extent to which the infra-red light is scattered by the water, means for passing green light through the water, and second sensor means for sensing the extent to which the green light is transmitted through the water, and means responsive to signals from both the first and the second sensor means to determine the concentrations of both the organic liquid and of the ferric floc in the water.

The organic liquid may be kerosene. The instrument is applicable where the floc concentration is typically in the range 0 to 250 ppm, and where the kerosene concentration is in the range 0 to 250 ppm. The water may be pure, or may contain chemicals in solution such as nitric acid which have negligible effect on the scattering or transmission of the light passed through the water.

It has been discovered that the oil-sensitive bilge-water monitor mentioned above can be used to monitor kerosene, but that it also detects ferric floc and is approximately as sensitive to ferric floc as it is to kerosene. Consequently if both ferric floc and kerosene may be present then measurements obtained with that monitor do not enable the concentration of either kerosene or of ferric floc to be determined independently. Using green light, the absorption is principally due to the ferric floc. Hence by measuring the degree of scattering of infra-red and the transmission of green light, the concentrations both of ferric floc and of kerosene can be determined independently.

The invention also provides a method for monitoring for the presence in water of both ferric floc and and immiscible organic liquid, the method comprising causing infra-red light and green light to propagate through the water, measuring the extent to which the infra-red light is scattered and the extent to which the green light is transmitted by the water, and hence determining the concentrations of the ferric floc and of the organic liquid in the water.

The invention will now be further described, by way of example only and with reference to the accompanying drawings, in which:

Figure 1 shows a diagrammatic view of a water-monitoring instrument; and

Figure 2 shows graphically the variations of signals in the circuit of Figure 1 for variations in floc and kerosene concentration.

Referring to Figure 1, the instrument 10 includes a glass tube 12 through which water is caused to flow, and monitors the water for both ferric floc and odourless kerosene. The instrument 10 comprises an infra-red light emitting diode 14 and a green light emitting diode 16 each connected electrically to respective terminals of a power supply 18 and mounted on or adjacent to the tube 12 so as to send a beam of radiation diametrically across the tube 12. Directly opposite the diode 14 is a light sensitive diode 20 arranged to receive the infra-red light transmitted through the water, and arranged at right angles to the transmitted beam is a second light sensitive diode 22 to receive infra-red light scattered by the water. Signals from these diodes 20 and 22 are amplified and then compared by a unit 24 which provides an output signal A representing the ratio of the scattered light to the transmitted light. Similarly, a light sensitive diode 26 is arranged directly opposite the diode 16, so as to receive the green light transmitted through the water and the signal from this diode 26 is amplified and then compared by a unit 30 to the corresponding signal when the water is clean; the unit 30 provides an output signal B representing the natural logarithm of the ratio of the transmitted light with clean water to the transmitted light as observed. Connected electrically in series with the diode 16 is another green light emitting diode 15, identical with the diode 16; this transmits light to a light sensitive diode 25, whose signals are amplified by a unit 28 and fed back to the power supply 18 to control the current supplied to the diodes 15 and 16 and so to ensure that the green light emission does not vary for example with the temperature of the diodes 15 and 16.

The output signal from the unit 24 represents the extent to which the water scatters the infra-red light, and

is substantially unaffected by any variation in the brightness of the emitted light beam from the diode 14.

The feedback circuit 15, 25, 28 ensures that there is substantially no variation in the brightness of the light beam from the diode 16, so the output signal from the unit 30 accurately represents the extent to which the transmission of green light is affected by the water.

The signals from the units 24 and 30 are received by a hard-wired calculating unit 32 which determines from them the concentrations of ferric floc and of kerosene, providing signals to two display units 34 and 36 which indicate respectively the concentration of ferric floc and the concentration of odourless kerosene in the water.

Referring to Figure 2, this shows graphically the variation of the output signals from the units 24 and 30 (signals A and B respectively), with either kerosene or ferric floc, but not both, in the water; the plotted values were obtained from experimental measurements. It will be apparent that the scattering of the infra-red light (A) is directly proportional to the concentration of either ferric floc or of kerosene, though kerosene scatters infra-red light about one and a half times more than does ferric floc. The decrease in the transmission of green light expressed logarithmically (B) is also directly proportional to the concentration of either ferric floc or of kerosene, but kerosene affects the transmission less than a fifth as much as does ferric floc. When both kerosene and ferric floc are present, their effects on both the scattering of infra-red light and the transmission of green light are merely additive. Thus for a kerosene concentration k and a ferric floc concentration f the values of these signals are given by:

$$A = a k + b f$$
$$B = c k + d f$$

where a, b, c and d are the gradients of these calibration graphs. Knowing the values of the gradients a, b, c and d, unknown values of k and f can readily be determined from measurements of A and B by mathematical solution of these two simultaneous algebraic equations.

It will be appreciated that the concentrations can be calculated using analogue signals and a hard-wired calculation circuit 32 as described above. Alternatively amplified signals from the diodes 20, 22, 26 and 25 may be digitized, and all the calculations performed digitally, using a microprocessor for example. In this case the feedback from the amplifier 28 to the power supply 18 can be dispensed with, and instead the digitized signal from the diode 25 used to normalize the signal from the diode 26 to take into account variations in the light emitted by diodes 15 and 16. To obtain accurate measurements it is necessary to take into account any variations in the brightness of the emitted light beams, and in the method described above this is done for the infra-red by measuring the transmitted beam using diode 20, while it is done for the green by measuring with the diode 25 the brightness of the light emitted by the diode 15 in series with the diode 16. If light sources other than light-emitting diodes were to be used instead, other monitoring techniques might be practical; for example a light beam from a laser might be passed through a beam splitter before entering the water, and the intensity of the beam split off by the beam splitter be monitored.

Claims

1. An instrument for monitoring for the presence in water of both ferric floc and an organic liquid immiscible with water, the instrument comprising means for passing infra-red light through the water, and first sensor means for sensing the extent to which the infra-red light is scattered by the water, means for passing green light through the water, and second sensor means for sensing the extent to which the green light is transmitted through the water, and means responsive to signals from both the first and the second sensor means to determine the concentrations of both the organic liquid and of the ferric floc in the water.

2. An instrument as claimed in Claim 1 also comprising means to ensure that the determined concentrations are not affected by any variations in the intensities of the emitted lights.

3. A method for monitoring for the presence in water of both ferric floc and immiscible organic liquid, the method comprising causing infra-red light and green light to propagate through the water, measuring the extent to which the infra-red light is scattered and the extent to which the green light is transmitted by the water, and hence determining the concentrations of the ferric floc and of the organic liquid in the water.

4. An instrument for monitoring for the presence in water of both ferric floc and an organic liquid immiscible with water, substantially as hereinbefore described with reference to, and as shown in, Figure 1 of the accompanying drawings.

5. A method for monitoring for the presence in water of both ferric floc and immiscible organic liquid, substantially as hereinbefore described with reference to, and as shown in, the accompanying drawings.

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